Monsanto
Enviro·
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Systems Inc.

10 SOUTH RIVERSIDE PLAZA / CHICAGO, ILLINOIS 60606

154055

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CAPITAL AND OPERATING COST BREAKOUTS

FOR THE

VILLAGE OF SAUGET WASTE WATER
TREATMENT SYSTEM
DECEMBER 31,1971

December 31, 1971

Village of Sauget Sanitary Development
  and Research Association
c/o Village of Sauget
Village Hall
2987 Monsanto Avenue
Sauget, Illinois

Gentlemen:

In accordance with the terms of our proposals of 11/8/71
and 11/18/71, we submit herewith a report indicating capital
cost and operating cost breakouts for the proposed Village
of Sauget waste water treatment system. Because of the change
in the proposed effluent criteria for the State of Illinois
issued on 11/15/71, we have estimated a plant with both a
storage lagoon for the "first flush" of storm water and a
primary clarifier for the storm flow in excess of design
capacity.

In this report we have also included capital and operating
cost breakouts for four (4) separate cases not specified in
our proposals of 11/71. These cases show the effect of various
in-battery limits modifications to reduce flow and contaminant
levels at the sources. Even though this information relates to
work being done for the Village, we felt that it is absolutely
necessary to have cost information at this time to determine
if in-plant treatment and recycle can be justified using as a
base case end of pipe treatment costs.

We of course recognize that our four cases do not include all of
the possible permutations or combinations of possible in-plant
reductions. They do, however, indicate where one should concentrat
his company's efforts in evaluating methods for reducing capital
and operating costs for waste water treatment.

If you have any questions on how the costs for each contributor
were estimated, please contact me or W. J. Fahrner.

Very truly yours,

J. L. Jones

JLJ/ck

DISTRIBUTION LIST

Village of Sauget Board of Trustees	2
Village of Sauget Sanitary Development	
and Research Association	
American Metals Climax Co.	2
Edwin Cooper Inc.	2
Cerro Corporation	2
Midwest Rubber Reclaiming Co.	2
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SUMMARY

This report presents breakouts of the capital and operating cost estimates by industry and the Village for the Village of Sauget, Illinois. Costs have been worked out for seven separate cases involving flow reductions, soluble COD reductions and acidity reductions.

Assumptions and calculation methods are described in the body of the report.

Estimated total capital and operating cost contributions for each waste contributor have been listed in summary Tables 1 and 2.

SUMMARY TABLE
SUMMARY OF CAPITAL COST BREAKDOWN *
(CASES 1 thru 7)
INDIVIDUAL CONTRIBUTORS

Case No.	1	2	3	4	5	6	7
SOURCE							
1. American Metals Climax	2533.6	0	361.9	396.1	396.1	437.1	438.7
2. Edwin Cooper	1393.4	1534.9	1512.9	1072.1	908.1	1004.4	1012.0
3. Cerro Corp.	935.1	1072.0	1051.6	849.3	849.3	947.7	948.5
4. Midwest Rubber Reclaiming Co.	393.4	424.9	411.7	427.7	316.0	349.2	349.2
5. Monsanto Ind. Chem. Co.	7312.0	8143.5	7986.4	7747.7	7490.4	6031.8	6021.0
6. Village of Sauget	39.5	48.7	49.5	51.1	51.1	56.8	58.1
TOTALS	$12,607	$11,224	$11,374	$10,544.	$10,011	$ 8,827	$8,827

* All costs expressed in thousands of dollars

SUMMARY TABLE
SUMMARY OF TOTAL OPERATING COSTS *
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTORS

CASE	1	2	3	4	5	6	7
American Climax Co.	384	0	62	67	68	75	74
Cerro Corporation	135	151	156	126	126	143	142
Edwin Cooper	623	647	649	511	336	354	349
Midwest Rubber Reclaim.	251	256	254	258	140	145	145
Monsanto Ind. Chem.	2,827	2,959	2,947	2,970	2,597	2,069	1,932
TOTALS	$4,220	$ 4,013	$4,068	$3,932	$3,267	$2,786	$2,642

Village costs are negligible.

* All costs in thousands of Dollars/year

INTRODUCTION

During the course of the on-site studies being conducted by Enviro-Chem for the Village of Sauget, Illinois, a number of alternative waste water collection and treatment schemes were evaluated. Reports were issued on 7/20/71 and 10/15/71 - "Preliminary Laboratory and Inplant Evaluation" and "Study of Alternative Waste Water Collection and Treatment Systems".

After a review of the 10/15/71 report, the Sauget Sanitary Development and Research Association requested more information on costs for each industry within the Village of Sauget. This request was made at the Technical Review Committee meeting on 10/22/71.

Up until the time of the 10/15/71 report, enough data was not available on proposed standards and from the pilot plant study work to accurately evaluate the costs for treatment. By presenting a cost breakout for the proposed Village treatment system, industry will now be able for the first time to accurately compare in-plant treatment costs with end of pipe treatment.

SCOPE

Because of changes in the proposed criteria on 11/15/71 regarding treatment of storm water, the scope outlined in the original proposal was changed to read as follows:

The capital and operating cost breakouts will be based on the capital and operating cost estimates in the report of 10/15/71. Alternative IA with slight modification will be considered as the base case. The modifications will include:

1. Inclusion of a storage lagoon for the "first flush" of storm water.

2. Resizing of clarifiers utilizing more complete data from the pilot plant.

The modified alternative IA will hereafter be referred to as IA.'

The three cases that will be evaluated under this contract are:

1. <u>Village chooses Alternative IA'</u> - All discharges will be comparable to what have been observed by Enviro-Chem since 8/70 with the exception that Midwest will divert 2.0 MGD of cooling water.
(Amax will discharge 6.21 MGD of water.)

2. Same as case one, except no discharge from Amax.

3. Same as case one, except Amax reduces cooling water discharge and the total discharge from their plant will be about 0.65 MGD.

Four additional cases concerned with changes in capital and/or operating costs resulting from in-battery limits modifications will also be included in this report. These four cases relate to work done under the 5/70 proposal to the Village under paragraph 6 - In-battery limits modifications.

The four cases include consideration of flow reductions, soluble COD reductions, and acidity reduction.

CASES FOR CONSIDERATION

The flow diagram for the proposed process has been shown in Figure 2. This is the same basic diagram as outlined in the report on "Alternative Waste Water Collection and Treatment Systems" - October 15, 1971, with the sulfide addition step removed and a storage lagoon for the "first flush" of storm water and a primary clarifier for excess storm flow added. The plant capacity has been increased by 0.4 MGD to handle the "first flush" of storm water. (Note appendix I for Calculations).

Cases 1, 2, and 3 will show cost breakouts with no change in the flows from Edwin Cooper (2.2 MGD), Cerro (2.2 MGD), Midwest Rubber (0.17 MGD), Monsanto Industrial Chemicals (12.6 MGD), and the Village (0.1 MGD). AMAX will discharge 6.21 MGD for case 1, no discharge for case 2, and 0.65 MGD for case 3.

Four other cases will be considered to show the effect of in-battery limits modifications on capital and operating costs. Each industry must equate savings in capital and operating costs versus cost at the source for treatment.

For cases 4, 5, 6, and 7, AMAX will discharge 0.65 MGD. For cases 4, 5, 6, and 7 Edwin Cooper, Cerro, and Midwest will discharge 1.2 MGD, 1.6 MGD, and 0.17 MGD respectively. Monsanto will discharge 10.8 MGD for cases 4 and 5, and 7.6 MGD for cases 6 and 7.

Reduction in the discharge of soluble COD will also be considered. For case 5 Edwin Cooper and Midwest will each reduce their discharge by about 50% and Monsanto will reduce their discharge by 25%. For cases 6 and 7 there will be no change from case 5 for Cooper and Midwest, but Monsanto will have a 50% reduction in soluble COD.

In case 7 Monsanto will also reduce their acid discharge by 15,000,000 lbs/year of HCl.

The above mentioned cases have been summarized in Tables 1 thru 4.

LIME STORAGE

SLUDGE HANDLING

SCUM

NEUTRALIZATION BASINS — FLOCCULATION BASINS — CLARIFIERS — PUMPING STATION #2 — FILTERS — PUMPING STATION #3 — ACTIVATED CARBON SYSTEM — CORPS OF ENGINEERS PUMPING STATION — RIVER

POLYMERS

(136.4 CFS)

SCUM

(128.5 CFS) — BAR SCREEN — GRIT CHAMBER — EXISTING PUMPING STATION #1

BACKWASH CLARIFIER

BACKWASH WATER STORAGE

(92.1 CFS)

STORAGE LAGOON

SLUDGE HANDLING

PRIMARY CLARIFIER

Table 1

Flow Bases for Village of Sauget Treatment Plant

Cases	1 (1A')	2 (AMAX Out)	3 (AMAX In)
Source			
American Metals Climax	6.21 MGD	0 MGD	0.65 MGD
Edwin Cooper, Inc.	2.2	2.2	2.2
Cerro Corporation	2.2	2.2	2.2
Midwest Rubber Reclaiming Co.	0.17	0.17	0.17
Monsanto Industrial Chemical Co.	12.6	12.6	12.6
Village	0.1	0.1	0.1
Dry Weather Flow	23.48	17.27	17.92
Storm Water Flow Capacity	0.4	0.4	0.4
Design Capacity	23.88 MGD	17.67 MGD	18.32 MGD

Table 2

Flow Bases for Village of Sauget Treatment Plant
(In-Battery Limits Modifications)

Cases	4	5	6	7
Source				
American Metals Climax	0.65 MGD	0.65 MGD	0.65 MGD	0.65 MGD
Edwin Cooper, Inc.	1.2	1.2	1.2	1.2
Cerro Corporation	1.6	1.6	1.6	1.6
Midwest Rubber Reclaiming Co.	0.17	0.17	0.17	0.17
Monsanto Industrial Chemical Co.	10.8	10.8	7.6	7.6
Village	0.1	0.1	0.1	0.1
Dry Weather Flow	14.52	14.52	11.32	11.32
Storm Water Flow Capacity	0.4	0.4	0.4	0.4
Design Capacity	14.92 MGD	14.92 MGD	11.72 MGD	11.72 MGD

Table 3

Basis for Cost Breakout-Activated Carbon System
Soluble COD Levels

Daily Discharges

Cases 1,2,3,4	Edwin Cooper	9,000 lbs.	16.4%
	Monsanto	40,000 lbs.	73.0%
	Midwest Rubber	5,800 lbs.	10.6%
		54,800 lbs.	

Case 5	Edwin Cooper	4,500 lbs.	12.1%
	Monsanto	30,000 lbs.	80.4%
	Midwest Rubber	2,800 lbs.	7.5%
		37,300 lbs.	

Case 6, 7	Edwin Cooper	4,500 lbs.	16.4%
	Monsanto	20,000 lbs.	73.4%
	Midwest Rubber	2,800 lbs.	10.2%
		27,300 lbs.	

American Metals Climax)   COD levels after lime treatment shown
Cerro Corporation   )   to be below an average value of 50 mg/l.

Table 4

Description of In-Battery Limits Modifications
for Various Industries within the Village of Sauget

Case 4

Cerro reduces flow by	0.6 MGD
Cooper reduces flow by	1.0 MGD
Monsanto reduces flow by	1.8 MGD
Essentially "Clean Water" Removed	3.4 MGD Reduction

Case 5 Flow Reductions same as 4

Waste load reductions:

Cooper's soluble COD load reduced by	4,500 lbs.
Monsanto's soluble COD load reduced by	10,000 lbs.
Midwest Rubber's soluble COD load reduced by	3,000 lbs.
	17,500 lbs. Reduction

Case 6 Flow reduction for Cerro and Cooper the same as for Cases 4 & 5

	0.6 MGD
	1.0 MGD
Monsanto reduces flow by	5.0 MGD
	6.6 MGD Reduction

COD Waste load reductions same as for Case 5 for Cooper & Midwest

	4,500 lbs.
	3,000 lbs.
Monsanto reduces soluble COD load by	20,000 lbs.
	27,500 lbs. Reduction

Case 7 Same as Case 6 except Monsanto reduces acid discharge by 15,000,000 lb/year of HCl.

CAPITAL AND OPERATING COST CLASSIFICATIONS

In Figure 2 the system has been divided into ten separate categories for breakout of capital costs. After the capital costs have been divided among these nine units, the cost for each unit will be distributed among the contributing industries based on the volume and the character of the waste discharge. This type of breakout will be done for all seven cases.

Operating costs will not be assigned to these nine above mentioned units but instead to cost centers such as:

Directs

    Chemicals
        Lime
        Polymers
    Carbon Regeneration and Operation
    Manpower
    Utilities
    Maintenance
    Sludge Disposal

Each cost will be distributed among the contributing industries for all cases.

Fig. 2
Basic Units of Village of Sauget Treatment Facility
(Proposed)

To River

RAW WASTE →

BAR SCREENS STORAGE LAGOON PRIMARY CLARIFICATION

EXISTING PUMPING STATION GRIT CHAMBER

NEUTRALIZATION COAGULATION FLOCCULATION Basins

CLARIFICATION

FILTRATION BACKFLUSH PUMPING STATION

CARBON MAKE-UP

ACTIVATED CARBON TREATMENT

TO RIVER

pH control Lime Storage & Feeding

SLUDGE HANDLING

CARBON REGENERATION

TO DISPOSAL

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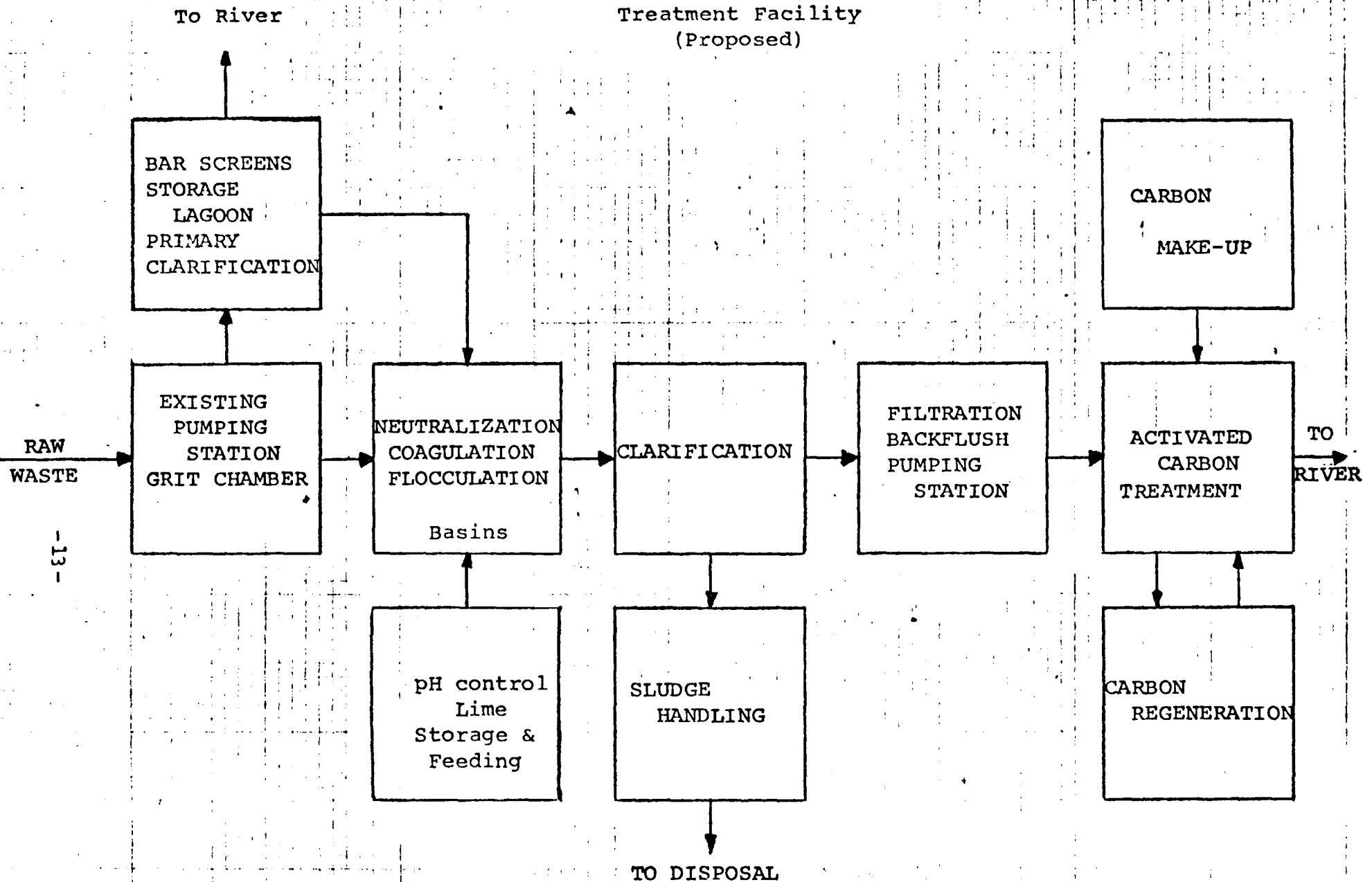
CAPITAL COST BREAKOUT FORMULA

The capital cost distribution for each case explained in Tables 1 thru 4 for a particular industry is based upon the following type of formula:

Example case 1:

$$a_1 c_A + b_1 c_B + \ldots + x_1 c_X = c_{T_1}$$

Where

a_1, b_1, c_1, etc. are the individual case 1 factors for each industry's fraction of the given units' capital cost.

c_A, c_B, c_C, etc. are the case 1 capital costs for each unit operation in the treatment plant.

c_{T_1} = Total individual industry cost (for case 1 in this example)

X = Total number of treatment plant unit operations

The individual industry cost factors are based upon that industry's portion of the total parameter under consideration. The parameter assigned to distribute a particular unit operation's capital cost is described in next section of this report. The parameter portion assigned to each industry was calculated using the best analytical data and/or engineering estimate available concerning that industry's present and future pollution loads.

BASES FOR CAPITAL COST PARAMETER ASSIGNMENT

In order to obtain a breakout of each industry's "fair share" of the total waste treatment capital costs, the Alternate IA' capital estimate was broken out to obtain capital costs for each treatment plant unit operation. The subsequent distribution of these capital costs was based upon the assignment of some measurable waste water parameter as the item most significantly affecting the system cost. The bases for these parameter assignments are listed below, with explanations if necessary:

Unit Operation	Parameter
A. Screening and Lagooning	Flow
B. Grit Chambers	Flow
C. Neutralization, Coagulation, Flocculation Chambers	Flow
D. Lime Storage, Feed, Control (The lime system necessity and sizing are dependent upon the waste acidity.)	Acidity
E. Clarification	Flow
F. Filtration and Backwash	Flow
G. Carbon Columns	Flow
H. Regeneration System	COD
I. Carbon Make-Up (The sizes of the regeneration equipment and the initial carbon fill are controlled primarily by the amount of COD to be removed from the waste - i.e. the amount and rate at which the carbon is exhausted.)	COD

J.   Sludge Handling   Suspended Solids
                                              Sulfates
                                              Carbonates
                                              Heavy Metals

     The amount of solids generated in and captured by the
treatment plant is dependent on the four above mentioned para-
meters under J.   The choice of these parameters was based on
the following information:

     A.   Suspended Solids - Essentially 100% of the suspended
          solids entering the system will be captured by both
          the clarification and filtration steps.

     B.   Heavy Metals - Removal of heavy metal hydroxides
          formed during neutralization will be almost complete
          in the subsequent sedimentation and filtration steps.

     C.   Carbonates - Pilot plant sludge analysis indicated
          the presence of substantial quantities of carbonates
          (approximately 40%).   Therefore, all carbonate
          sources were included in the sludge handling calcu-
          lations including an average background carbonate
          hardness of 250 mg/l.

     D.   Sulfates - the vast majority of the sulfates in the
          waste are soluble.   However, concentrated SO_4=dumps
          (especially H_2SO_4) will cause sludge generation
          ($CaSO_4$).

          Sludge analyses indicate that 8.35% of the sludge
          is $CaSO_4$.

          Assuming a 100 T/day sludge generation rate, then a
          $CaSO_4$ quantity of 16,700 lbs/day would be expected.
          From waste analyses and material balances, it has
          been calculated that 192,000 lbs/day of SO_4=is dis-
          charged to the sewer.   Therefore, for any individual
          SO4 source, $(\frac{16,700}{192,000})$ times his sulfate discharge will
          be considered to be insoluble (8.7%) based on sludge
          analysis.

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Again it must be emphasized that these assumptions and calculations are based on the best material balance, and projection available. As contributions change, and more statistically significant data is obtained on actual plant operation, these calculations will undoubtedly be modified and updated.

CAPITAL COST BREAKOUTS

The total capital cost for each of the seven cases being evaluated has been listed in Table 5 as well as the cost for each of the ten basic units within the treatment facility.

Tables 6 thru 11 list the cost to the five major contributing industries and the Village for each basic unit for all seven cases. Table 12 is a summary table indicating the total capital cost to each industry for each use.

Table 5 *
Capital Costs (Cases 1 through 7) Village Treatment Facility

CASES

			1	2	3	4	5	6	7
	Unit Operation Basis (Flows)		23.88 MGD Alt IA'	17.67	18.32	14.92	14.92	11.72	11.7
I	Scr. & Lag. A=Scr. & Lag. (Flow) B=Prim. Basin		A 114 B 190	A 114 B 190	A 114 B 190	A 114 B 190	A 114 B 190	A 114 B 190	A 11 B 19
II	Grit Chamber (Flow) (Pumping)		298	249	254	225	225	195	19
III	Neutr. Coag, (Flow) Floc., (Lime, no NaHS)		1,007	841	859	759	759	658	65
IV	Lime Storage (Acidity) Handling, Control		391	391	391	391	391	391	39
V	Clarification (Flow)		2,565	2,142	2,188	1,934	1,934	1,675	1,675
VI	Filtration Back-wash, Pumping (Flow)		2,009	1,678	1,714	1,515	1,515	1,312	1,31
VII	Carbon Cols. (Flow)		2,508	2,094	2,139	1,891	1,891	1,638	1,63
VIII	Regeneration (COD)		1,816	1,816	1,816	1,816	1,442	1,195	1,19
IX	Carbon Make-up (COD)		498	498	498	498	339	248	24
X	Sludge Handling (Solids)		1,211	1,211	1,211	1,211	1,211	1,211	1,21
	Totals		$12,607	$11,224	$11,374	$10,544	$10,011	$8,827	$8,82

* All costs expressed in thousands of dollars

TABLE 6
CAPITAL COST BREAKOUT *
(Cases 1 through 7)

AMERICAN METALS CLIMAX CO.

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	80.3	–	10.9	13.7	13.7	17.3	17.
2. Grit Chamber	78.7	–	9.1	10.1	10.1	11.1	11.
3. Neutralization, Coagulation, Flocculation	265.8	–	30.9	34.2	34.2	37.5	37.
4. Lime Storage, Feed, Control	22.3	–	6.3	7.0	7.0	7.0	8.
5. Clarification	677.2	–	78.8	87.0	87.0	95.5	95.
6. Filtration, Backwash, Pumping	530.4	–	61.7	68.2	68.2	74.8	74.
7. Carbon Columns	662.1	–	77.0	85.1	85.1	93.4	93.
8. Regeneration	–	–	–	–	–	–	–
9. Carbon Make-Up	–	–	–	–	–	–	–
10. Sludge Handling	216.8	–	87.2	90.8	90.8	100.5	100.
TOTALS	$ 2533.6	0.0	$361.9	$396.1	$396.1	$437.1	$438.

* All costs expressed in thousands of dollars

TABLE 7
CAPITAL COST BREAKOUT *
(Cases 1 through 7)
EDWIN COOPER, INC.

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	28.6	38.6	37.4	25.2	25.2	32.2	32.2
2. Grit Chamber	28.0	31.6	31.2	18.7	18.7	20.7	20.7
3. Neutralization, Coagulation, Flocculation	94.7	106.8	105.7	63.0	63.0	69.7	69.7
4. Lime Storage, Feed, Control	79.4	84.5	82.9	37.1	37.1	37.1	44.2
5. Clarification	241.1	272.0	269.1	160.5	160.5	177.6	177.6
6. Filtration, Backwash Pumping	188.8	213.1	210.8	125.7	125.7	139.1	139.1
7. Carbon Columns	235.8	265.9	263.1	157.0	157.0	173.6	173.6
8. Regeneration	297.8	297.8	297.8	297.8	174.5	197.2	197.2
9. Carbon Make-Up	81.7	81.7	81.7	81.7	41.0	40.9	40.9
10. Sludge Handling	117.5	142.9	133.2	105.4	105.4	116.3	116.3
TOTALS	$1393.4	$1534.9	$1512.9	$1072.1	$908.1	$1004.4	$1012.0

* All costs expressed in thousands of dollars

TABLE 8
CAPITAL COST BREAKOUT *
(Cases 1 through 7)
CERRO CORPORATION

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	28.6	38.6	37.4	33.4	33.4	42.9	42.9
2. Grit Chamber	28.0	31.6	31.2	24.8	24.8	27.5	27.5
3. Neutralization, Coagulation, Flocculation	94.7	106.8	105.7	83.5	83.5	92.8	92.8
4. Lime Storage, Feed, Control	3.1	3.5	3.5	3.9	3.9	3.9	4.7
5. Clarification	241.1	272.0	269.1	212.7	212.7	236.2	236.2
6. Filtration, Backwash Pumping	188.8	213.1	210.8	166.7	166.7	185.0	185.0
7. Carbon Columns	235.8	265.9	263.1	208.0	208.0	231.0	231.0
8. Regeneration	–	–	–	–	–	–	–
9. Carbon Make-Up	–	–	–	–	–	–	–
10. Sludge Handling	115.0	140.5	130.8	116.3	116.3	128.4	128.4
TOTALS	$935.1	$1072.0	$1051.6	$849.3	$849.3	$947.7	$948.5

* All costs expressed in thousands of dollars

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TABLE 9
CAPITAL COST BREAKOUT *
(Cases 1 through 7)
MIDWEST RUBBER RECLAIMING CO.

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	2.1	3.0	2.7	3.6	3.6	4.6	4.6
2. Grit Chamber	2.1	2.5	2.3	2.7	2.7	2.9	2.9
3. Neutralization, Coagulation, Flocculation	7.0	8.4	7.7	9.1	9.1	9.9	9.9
4. Lime Storage, Control	–	–	–	–	–	–	–
5. Clarification	18.0	21.4	19.7	23.2	23.2	25.1	25.1
6. Filtration, Backwash Pumping	14.1	16.8	15.4	18.2	18.2	19.7	19.7
7. Carbon Columns	17.6	20.9	19.3	22.7	22.7	24.6	24.6
8. Regeneration	192.5	192.5	192.5	192.5	108.2	123.1	123.1
9. Carbon Make-Up	52.8	52.8	52.8	52.8	25.4	25.5	25.5
10. Sludge Handling	87.2	106.6	99.3	102.9	102.9	113.8	113.8
TOTALS	$393.4	$424.9	$411.7	$427.7	$316.0	$349.2	$349.2

* All costs expressed in thousands of dollars

TABLE 10
CAPITAL COST BREAKOUT *
(Cases 1 through 7)
MONSANTO INDUSTRIAL CHEMICALS CO.

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	163.2	222.0	213.8	226.0	226.0	204.3	204.3
2. Grit Chamber	160.0	181.8	178.7	167.1	167.1	131.0	131.0
3. Neutralization, Coagulation, Flocculation	540.8	614.0	603.8	563.9	563.9	442.2	442.2
4. Lime Storage, Feed Control	286.2	303.0	298.3	343.0	343.0	343.0	333.5
5. Clarification	1377.3	1563.7	1538.2	1437.1	1437.1	1125.5	1125.5
6. Filtration, Backwash, Pumping	1078.9	1224.9	1205.0	1125.6	1125.6	881.6	881.6
7. Carbon Columns	1346.7	1528.7	1503.7	1405.0	1405.0	1100.7	1100.7
8. Regeneration	1325.7	1325.7	1325.7	1325.7	1159.3	874.7	874.7
9. Carbon Make-Up	363.5	363.5	363.5	363.5	272.6	181.6	181.6
10. Sludge Handling	669.7	816.2	755.7	790.8	790.8	747.2	745.9
TOTALS	$7312.0	$8143.5	$7986.4	$7747.7	$7490.4	$6031.8	$6021.0

* All costs expressed in thousands of dollars

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TABLE 11
CAPITAL COST BREAKOUT *
(Cases 1 through 7)
VILLAGE OF SAUGET

Case No.	1	2	3	4	5	6	7
CATEGORY							
1. Screening and Lagooning	1.2	1.8	1.8	2.1	2.1	2.7	2.7
2. Grit Chamber	1.2	1.5	1.5	1.6	1.6	1.8	1.8
3. Neutralization, Coagulation, Flocculation	4.0	5.0	5.2	5.3	5.3	5.9	5.9
4 Lime Storage, Feed Control	-	-	-	-	-	-	-
5. Clarification	10.3	12.9	13.1	13.5	13.5	15.1	15.1
6. Filtration, Backwash, Pumping	8.0	10.1	10.3	10.6	10.6	11.8	11.8
7. Carbon Columns	10.0	12.6	12.8	13.2	13.2	14.7	14.7
8. Regeneration	-	-	-	-	-	-	-
9. Carbon Make-Up	-	-	-	-	-	-	-
10. Sludge Handling	4.8	4.8	4.8	4.8	4.8	4.8	6.1
TOTALS	$39.5	$48.7	$49.5	$51.1	$51.1	$56.8	$58.1

* All costs expressed in thousands of dollars

TABLE 12

SUMMARY OF CAPITAL COST BREAKDOWN *
(CASES 1 thru 7)
INDIVIDUAL CONTRIBUTORS

Case No.	1	2	3	4	5	6	7
SOURCE							
1. American Metals Climax	2533.6	0	361.9	396.1	396.1	437.1	438.7
2. Edwin Cooper	1393.4	1534.9	1512.9	1072.1	908.1	1004.4	1012.0
3. Cerro Corp.	935.1	1072.0	1051.6	849.3	849.3	947.7	948.5
4. Midwest Rubber Reclaiming Co.	393.4	424.9	411.7	427.7	316.0	349.2	349.2
5. Monsanto Ind. Chem. Co.	7312.0	8143.5	7986.4	7747.7	7490.4	6031.8	6021.0
6. Village of Sauget	39.5	48.7	49.5	51.1	51.1	56.8	58.1
TOTALS	$12,607	$11,224	$11,374	$10,544.	$10,011	$ 8,827	$8,827

* All costs expressed in thousands of dollars

OPERATING COST BREAKOUT FORMULA

Direct Operating Costs

The operating cost for each of the ten basic units of the treatment system will be calculated from the following type of formula:

Example case 1

$$a_1 (OC)A + b_1 (OC)_B + \ldots + x_1 (OC)_X = (OC)_{T_1}$$

Where

a_1, b_1, c_1, etc. are the individual case 1 factors for each industry's fraction of the given unit operating cost.

OC_A, OC_B, OC_C, etc are the case 1 direct operating costs for each basic unit.

$(OC)_{T_1}$ = total direct operating cost for case one for a given industry.

X = total number of treatment plant units.

Indirect Operating Costs

It has been assumed that financing of the treatment plant will be accomplished by the Village selling $1,500,000 worth of general obligation bonds (5½%, 15 years) and the remainder of the plant will be financed with revenue bonds (6%, 30 years). The payments on general obligation bonds each year will be distributed according to the fraction of the total capital investment each industry and the Village accounts for. The revenue bond payments will be distributed according to the percentage of capital each industry accounts for with the Village excluded.

BASES FOR DIRECT OPERATING COST PARAMETERS AND CALCULATIONS

The bases used for calculation of direct operating costs have been listed in Table 13. An outline for the method used to assign the operating costs has been shown in Table XIV.

The method for assigning the direct costs has been summarized in Table 14. The sludge disposal cost is the most difficult cost to calculate because of the uncertainty in the method of disposal. We have assumed that the sludge can be disposed of in a landfill within the Village. (Note Appendix II).

Table 15 indicates the total operating cost for cases 1 through 7 for the items shown in Tables 13 and 14. Tables 16 through 20 list the direct operating costs for the individual industries. Table 21 summarizes the total direct operating costs for each contributor for each case. All operating costs are expressed on a yearly basis.

Table 13
Bases for Calculation of Direct Operating Cost

Item	Quantity	Total Price
Lime	84.5 tons/day	$20/ton
Polyelectrolyte	(1 mg/l)	$1.60/lb
Carbon (Total)	9.17 lbs/1000 gal	
Carbon make up (7% loss of Total)	0.64 lbs/1000 gals	0.26/lb
Misc. Chem. Supplies	---	$0.010/1000 gal
Sludge Disposal	100 tons dry solids/day	$2/ton
Manpower	8 men	$5/hour
Utilities (power)	---	8 mil /kw-hr
Maintenance	---	2% of capital

TABLE 14

METHOD FOR ASSIGNING DIRECT OPERATING COSTS

ITEM	DESCRIPTION
Carbon System	Carbon makeup, fuel for regeneration, utilities (Allocate totally to Midwest Rubber, Edwin Cooper & Monsanto based on COD load)
Lime	Allocate lime costs based on acidity contribution. No credit given to alkaline contributors.
Polymers	Allocate costs based on flow.
Misc. Chemicals & Supplies	Allocate costs based on flow.
Sludge	Allocate cost based on pounds generated by each contributor.
Utilities	Allocate costs based on flow.
Manpower	Allocate costs based on capital investment assigned to each contributor.
Maintenance	Allocate costs based on 2% times the capital investment assigned to each contributor.

TABLE 15

DIRECT OPERATING COSTS *
(Cases 1 - 7)
Village Treatment Facility

CASE	1	2	3	4	5	6	7
arbon	1,926	1,926	1,926	1,926	1,310	959	959
ime	637	601	637	600	600	600	457
olymers	113	84	87	71	71	56	56
iscellaneous chemicals	86	86	86	86	86	86	86
ludge	77	77	77	77	77	77	77
tilities	43	32	33	27	27	21	21
anpower	129	129	129	129	129	129	129
aintenance	252	224	227	211	200	177	177
TOTAL	$3,263	$3,159	$3,202	$3,127	$2,500	$2,105	$1,962

* Costs expressed in thousands of dollars per year

TABLE 16

DIRECT OPERATING BREAKOUT *
(CASES 1thru7)
AMERICAN METAL CLIMAX COMPANY

Case	1	2	3	4	5	6	7
Carbon	0	0	0	0	0	0	0
Lime	36	0	10	11	11	11	10
Polymers	30	0	3	3	3	3	3
Misc. Chem.	23	0	3	4	4	5	5
Sludge	14	0	6	6	6	6	6
Utilities	11	0	1	1	1	1	1
Manpower	26	0	4	5	5	6	6
Maintenance	51	0	7	8	8	9	9
TOTAL	$191	0	$34	$38	$38	$41	$40

* All costs expressed in thousands of dollars

TABLE 17

DIRECT OPERATING COST BREAKOUT *
(CASES 1 thru 7)

EDWIN COOPER, INC.

Case	1	2	3	4	5	6	7
Carbon	316	316	316	316	156	158	158
Lime	129	130	135	57	57	57	52
Polymers	11	11	11	6	6	6	6
Misc. Chem.	8	11	11	7	8	10	10
Sludge	7	9	8	7	7	8	8
Utilities	4	4	4	2	2	2	2
Manpower	14	18	17	13	12	15	15
Maintenance	28	31	31	21	18	20	20
TOTAL	$ 517	$530	$533	$429	$266	$276	$271

* All costs expressed in thousands of dollars

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TABLE 18

DIRECT OPERATING COST BREAKOUT *
(CASES 1 THRU 7)
CERRO CORPORATION

Case	1	2	3	4	5	6	7
Carbon	0	0	0	0	0	0	0
Lime	5	5	6	6	6	6	5
Polymers	11	11	11	8	8	8	8
Misc. Chem.	8	11	11	10	9	12	12
Sludge	7	9	8	7	7	8	8
Utilities	4	4	4	3	3	3	3
Manpower	10	12	12	10	11	14	14
Maintenance	19	21	21	17	17	19	19
TOTALS	$64	$73	$73	$61	$61	$70	$69

* All costs expressed in thousands of dollars

TABLE 19

DIRECT OPERATING COST BREAKOUT *
(CASES 1 THRU 7)
MIDWEST RUBBER RECLAIMING CO.

Case	1	2	3	4	5	6	7
Carbon	204	204	204	204	99	99	99
Lime	0	0	0	0	0	0	0
Polymers	0	0	0	0	0	0	0
Misc. Chem.	0	0	0	0	0	0	0
Sludge	5	7	6	7	7	7	7
Utilities	0	0	0	0	0	0	0
Manpower	4	5	5	5	4	5	5
Maintenance	8	8	8	9	6	7	7
TOTAL	$221	$224	$223	$225	$116	$118	$118

* All costs expressed in thousands of dollars

TABLE <u>20</u>

DIRECT OPERATING COST BREAKOUT *
(CASES 1 THRU 7)
MONSANTO INDUSTRIAL CHEMICAL

Case	1	2	3	4	5	6	7
<u>Carbon</u>	1406	1406	1406	1406	1055	702	702
<u>Lime</u>	467	466	486	526	526	526	390
<u>Polymers</u>	61	62	62	54	54	39	39
<u>Misc. Chem.</u>	47	64	61	65	65	59	59
<u>Sludge</u>	44	52	49	50	50	48	48
<u>Utilities</u>	24	24	24	21	21	14	14
<u>Manpower</u>	75	94	91	96	97	89	89
<u>Maintenance</u>	<u>146</u>	<u>164</u>	<u>160</u>	<u>156</u>	<u>151</u>	<u>123</u>	<u>123</u>
TOTAL	$2,270	$2,332	$2,339	$2,374	$2,019	$1600	$1464

* All costs expressed in thousands of dollars

TABLE 21 *

SUMMARY OF DIRECT OPERATING COSTS
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTORS

CASE	1	2	3	4	5	6	7
American Climax Co.	191	0	34	38	38	41	40
Cerro Corporation	64	73	73	61	61	70	69
Edwin Cooper	517	530	533	429	266	276	271
Midwest Rubber Reclaim.	221	224	223	225	116	118	118
Monsanto Ind. Chem.	2,270	2,332	2,339	2,374	2,019	1,600	1,464
TOTAL	$ 3,263	3,159	3,202	3,127	2,500	2,105	1,962

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* Costs expressed in thousands of dollars/year

Calculation of Indirect Operating Costs

It has been assumed that financing will be accomplished by floating $1,500,000 for general obligation bonds and the remainder with revenue bonds.

The payments for the G.O. bonds for 15 years will be $149,445/year. The approximate breakout has been shown in Table 22.

Table 23 lists the 30 yearly payments on revenue bonds for all 7 cases and Table 24 shows the total yearly indirect operating costs for the first 15 years.

TABLE 22

INDIRECT OPERATING COST BREAKOUTS (G.O. BONDS)
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTIONS

CASE	1	2	3	4	5	6	7
American Climax Co.	30,038	0	4,782	5,604	5,903	7,398	7,427
Midwest Rubber Reclaim.	4,663	5,649	5,395	6,052	4,708	5,918	5,918
Edwin Cooper	16,514	20,429	19,876	15,198	13,545	17,007	17,126
Monsanto Ind. Chem.	86,708	109,050	104,926	109,844	111,854	102,116	101,938
Cerro Corporation	11,074	13,674	13,823	12,030	12,673	16,050	16,050
Village of Sauget	448	643	643	717	762	956	986
TOTAL	$ 149,445	$149,445	$149,445	$149,445	$149,445	$149,445	$149,445

TABLE 23

INDIRECT OPERATING COST BREAKOUTS (REVENUE BONDS)
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTORS

CASE	1	2	3	4	5	6	7
American Climax Co.	162,595	0	22,955	24,639	24,424	26,349	26,455
Midwest Rubber Reclaim.	25,176	26,704	25,896	26,610	19,477	21,079	21,079
Edwin Cooper	89,003	96,854	95,694	67,018	56,206	60,682	61,109
Monsanto Ind. Chem.	470,196	518,110	503,218	485,756	465,660	366,921	366,494
Cerro Corporation	59,954	64,781	69,583	53,024	52,557	57,276	57,170
TOTALS	$ 806,924	$706,449	$717,346	$657,047	$618,324	$532,307	$532,307

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TABLE 24

TOTAL INDIRECT OPERATING COSTS
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTORS

CASE	1	2	3	4	5	6	7
American Climax Co.	192,633	0	27,737	29,243	30,327	33,747	33,882
Cerro Corporation	71,028	78,455	83,406	65,054	65,230	73,326	73,220
Edwin Cooper	105,517	117,283	115,570	82,216	69,751	77,689	78,235
Midwest Rubber Reclaim.	29,839	32,353	31,291	32,662	24,185	26,997	26,997
Monsanto Ind. Chem.	556,904	627,160	608,144	595,600	577,514	469,037	468,432
Village of Sauget	448	643	643	717	762	956	986
TOTAL	$956,369	$855,894	$866,791	$805,492	$767,769	$681,752	$681,752

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TOTAL OPERATING COSTS

Table 25 shows the total operating costs for the Village treatment facility and Table 26 summarizes the operating costs for the industrial contributors to the system.

TABLE 25

SUMMARY OF TOTAL OPERATING COSTS*
(CASES 1 THROUGH 7)
VILLAGE TREATMENT FACILITY

CASE		1	2	3	4	5	6	7
Direct		3,263	3,159	3,202	3,127	2,500	2,105	1,962
Indirect		956	856	867	805	768	682	682
	TOTAL	$ 4,219	$ 4,015	$ 4,069	$ 3,932	$ 3,268	$ 2,787	$ 2,644

* All costs in thousands of Dollars/year

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TABLE 26

SUMMARY OF TOTAL OPERATING COSTS *
(CASES 1 THROUGH 7)
INDIVIDUAL CONTRIBUTORS

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CASE	1	2	3	4	5	6	7
American Climax Co.	384	0	62	67	68	75	74
Cerro Corporation	135	151	156	126	126	143	142
Edwin Cooper	623	647	649	511	336	354	349
Midwest Rubber Reclaim.	251	256	254	258	140	145	145
Monsanto Ind. Chem.	2,827	2,959	2,947	2,970	2,597	2,069	1,932
TOTALS	$4,220	$ 4,013	$4,068	$3,932	$3,267	$2,786	$2,642

Village costs are negligible.

* All costs in thousands of Dollars/year

APPENDIX 1

STORM WATER RUNOFF. (BASES FOR CALCULATION OF FIRST FLUSH

VOLUME) "FIRST FLUSH"

A.   Sewer Contamination Build-Up

It has been assumed that the Village of Sauget's

main sewers have no appreciable contaminant build-up

because of the high, consistent scour velocities

in the sewers.

B.   Above Ground Contamination

Contaminants present on street, buildings, equipment

and grounds will add an unknown amount of contamination

to storm runoff. The contaminants washed off by the

rain water would be expected to be in concentrations

below the wastewater levels, thus storm runoff would

act as a diluent even during the first period of

the storm.

In any event, potential areas of rain water contamination

are limited to the acreage bounded by the darkened lines

on the attached map (note figure 3). Areas will include

0.5 A, B, 0.5 C, D, E, F, G, H, M, N, O, Q, R, S, 0.5

T, U, V, W, X, Y and AA totaling 185 acres or 8.059

million ft^2 (note table 27).

Table 27

RUNOFF CALCULATIONS

Section	Area (Acres)	Runoff Coefficient	Flow (cfs)	Remarks
A	17	--	1.2	Balance to Seepage Pond
B	7	0.7	7.7	0.7 cfs from D
C	13.3	0.7	14.6	0.6 cfs from E, 0.9 cfs from F
D	2.0	0.7	0	0.9 cfs to B, 1.0 cfs to O
E	2.8	0.7	0	0.7 cfs to A M, & N; 0.6 cfs to C
F	1.8	0.7	0	0.9 cfs to C & M
G	10	0.9	9.8	Parking Area
H	2.0	0.7	1.9	
I	--	--	--	Agricultural Are
J				From Pumping
K			16.7	Station, Maximum
L				Pumping Capacity
M	45	0.7	45.6	0.7 cfs from E; 0.9 cfs from F
N	5	0.7	5.6	0.7 cfs from E
O	14	0.7	14.7	1.0 cfs from D
P	---	---	---	Agricultural Are

Runoff Calculations (cont'd)

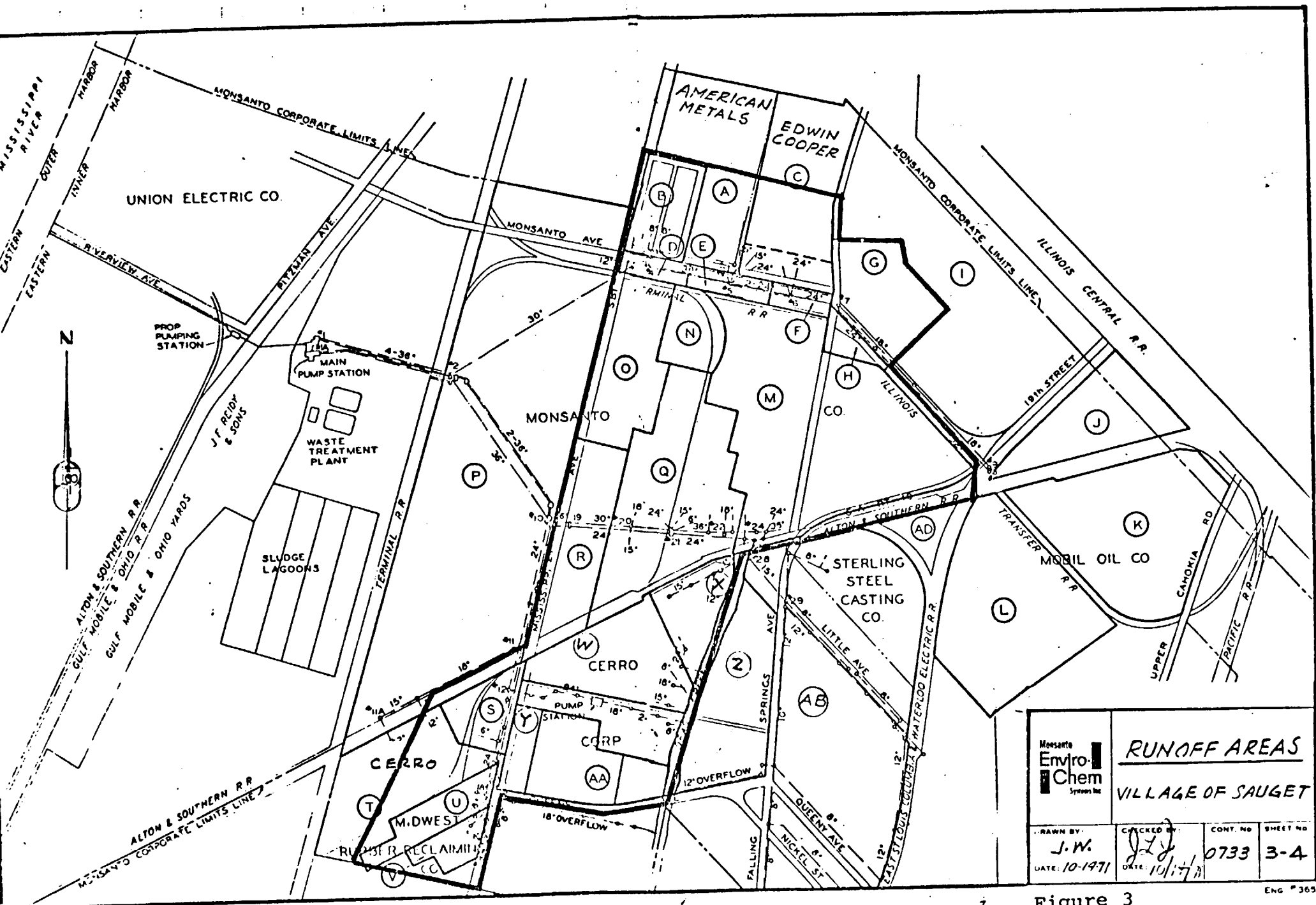| Section	Area (Acres)	Runoff Coefficient	Flow (cfs)	Remarks
Q	27	0.7	26.5	
R	14	0.7	13.7	Minor Flooding Allowed
S	--	--	1.0	Maximum Outlet Capacity
T	--	--	--	To Seepage Pond
U V	8.1	0.7	7.9	
W	11.8	0.7	11.5	
X	10.0	0.7	9.8	
Y	3.0	0.7	2.9	
Z	16.7	0.2	4.6	
AA	6.0	0.7	5.9	
AB	5	0.7	4.9	Street and Residential Runoff
Total			206.5	

Figure 3

C. Definition of First Flush .

  1. It has been assumed that the major portion of any
     possible above ground contaminants will be washed off
     in the first 0.2" of rainfall.

  2. Average runoff coefficient assumed to be 0.7

  3. First flush volume = V_{FF}

$$V_{FF} = \frac{185 \text{ acres X } 43,560 \text{ ft}^2/\text{acre X 0.2 in. X 0.7 X 7.}}{12 \text{ in./ft}} \text{ gal/ft}$$

     $V_{FF} \cong 800,000$ gal.

  4. The calculated volume of all main sewers in the
     potential contaminant area is 510,000 gal; thus,
     the surface wash will provide a volume sufficient
     to flush the main sewer approximately 1.6 times.
     In addition, clean storm runoff from uncontaminated
     areas will aid in the sewer "flush".

  5. V_{FF} = working volume of storage lagoon.

D. Arrival Lag of First Flush

  The arrival lag of the first flush water to the treatment
  plant will be governed by the surface runoff time and
  the sewer retention time.

  1. It was estimated that the runoff to sewer collection
     boxes will flow an average of 500 feet to the main

sewers at an average velocity of 2 ft/sec. (120ft/min

$$\frac{500 \text{ ft}}{120 \text{ ft/min}} = 4.2 \text{ min. surface runoff time.}$$

2. Sewer retention time is based upon a full-flow velocity of 5 ft/sec. (300 ft/min). $[4\text{-}36"$ sewers flowing at 128.5 cfs $= 4\left(\frac{\pi D^2}{4}\right) =$ sewer area $=$ $\pi(3)^2 = 28.3 \text{ ft}^2$, and $\frac{128.5 \text{ cfs}}{28.3 \text{ ft}^2} \cong 5 \text{ ft/sec.}]$ Since the longest main sewer run in the potential contaminant area is 4,300 ft, the expected sewer retention time is $\frac{4300 \text{ ft}}{300 \text{ ft/min}} = 14.3 \text{ min.}$

3. Therefore, the total delay of the arrival of the first 0.2" rainfall in reaching the treatment facility would be 14.3 + 4.2 = 18.5 min.

E.   Pumping Times

1. Minimum pumping time – in the case of an intense storm (i.e. 2"/hour for 30 min*) it is assumed that a full-flow condition (128.5 cfs) would be reached in the sewer very rapidly. [Flows of this order of magnitude would cause sewer back-up and overflow.] In such a condition, holding lagoon capacity would be reached in approximately 19.5 min (assuming treatment plant design flow of 16,580 gpm).

*See attached rainfall intensity – frequency curve.

2. Normal pumping time – "normal" pumping time is
defined as the time required to reach lagoon
holding capacity or 18.5 minutes after a total
rainfall accumulation of 0.2", whichever comes
first. The flows pumped to the holding lagoon
or the bypass primary treatment facility would
be only those flows exceeding design flows. All
flows not exceeding design flow (rainfall present
or not) will be accepted as normal raw waste to
the treatment system.

F.   Treatment of First Flush

The treatment system design capacity will be adjusted
to accept the first flush water volume of 800,000
gallons during the 48 hour period immediately following
cessation of storm flow conditions. In the event
storm conditions are resumed during this 48 hour
period, all flow exceeding design will be considered
post-first flush and diverted to the storm water
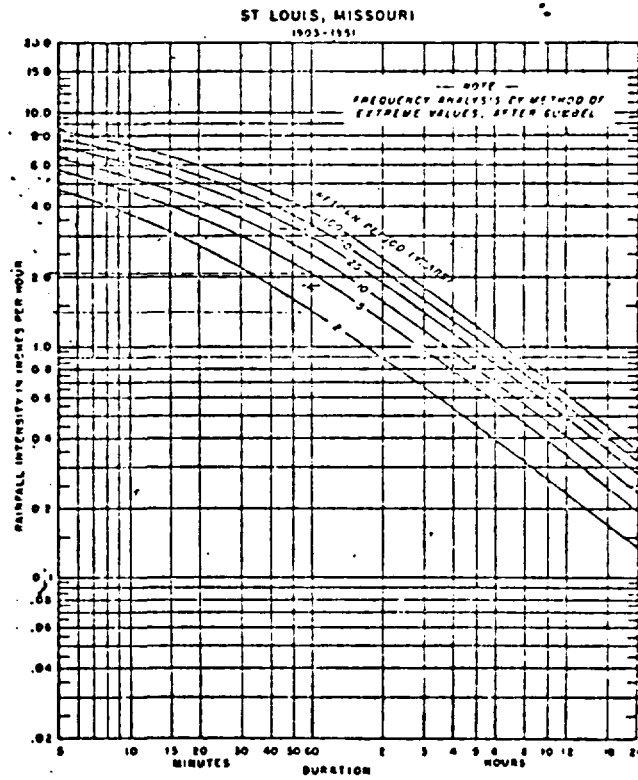primary system.

G.   Treatment of Storm Bypass Flows

It has been assumed that primary treatment of storm
bypass flows (under Part VI, Section C of the Proposed

Effluent Criteria) will consist of a settling

basin (Design Overflow Rate = 1800 - 2000 gal/ft^2 day).

Figure 4

RAINFALL INTENSITY - DURATION - FREQUENCY CURVES

APPENDIX 2

December 8, 1971
J. L. Jones

SUBJECT: WASTE SLUDGE DISPOSAL

Phone conversation with: George Sullivan - Administrative Assn't
                           to Richard Kissel - Illinois Pollution
                                               Control Board

On question of sludge disposal   Board has made no proposal
yet and has referred the question to the Institute for Environ-
mental Quality - Mr. Larry Hardin (312-793-3628).

Phone conversation with: Larry Hardin - Sanitary Engineer
                                          Institute for Envirnmental
                                          Quality.

Institute is comprised of three individuals (Michael Schneiderman,
Director, a lawyer; one urban planner; and one sanitary engineer-
Hardin).

Most of their work is contracted to consultants as evidenced
by the Waste Water Treatment Technology report done by the Illinois
Institute of Technology.

Engineering Science - A Washington D. C. based consulting firm
has been retained to study the solid wastes problems.

A state solids waste plan will not be available unitl about
January 1974, according to Mr. Hardin.

At this time, the Illinois EPA is very concerned with the leachate from sludges and they will be very adverse to any plan for landfilling a sludge where soil conditions and ground formations would lead to ground water contamination.

One probable criteria will be that no sludge will be acceptable for landfill unless the moisture content has been reduced to less than 80% by weight.

Impression of current Situation   December 8, 1971
                                                   J. L. Jones

EPA will essentially have control of sludge disposal until the state has finalized a plan for statewide control of sludge disposal. At this time, disposal of the lime sludge from Sauget at 25% solids by weight is the only viable option to consider. For economic analysis during final process design, landfill disposal costs will be used for the base case when considering procss options such as recalcination of the sludge.